

Engineering Identity Development of Hispanic Students

Abstract

This research paper investigates how Hispanic engineering undergraduate students develop their identity as engineers. Identity is emerging as a potential lens for predicting student persistence in engineering. Hispanic engineering students are of particular interest due to their underrepresentation in the field and prior engineering identity studies. In particular, we seek to understand which factors may influence Hispanic students' engineering identity development. We begin by answering the following research questions:

1. How do the engineering identity, extracurricular experiences, post-graduation career plans, and familial influence of Hispanic students attending a Hispanic Serving Institution (HSI) differ from those of Hispanic students attending a Predominantly White Institution (PWI)?
2. How do the same measures differ for Hispanic students attending a PWI from those of non-Hispanic white students at that PWI?
3. How do the same measures differ for Hispanic students attending an HSI from those of non-Hispanic white students at that HSI?

To do so, we used a quantitative assessment approach to measure engineering identity, extracurricular experiences, post-graduation career plans, and familial influence of Hispanic undergraduates. To assess engineering identity development, we administered an online survey to students at The University of Texas at Austin (the PWI) and The University of Texas at El Paso (the HSI). This survey instrument, validated previously, asks participants to respond to a series of Likert-style and multiple-choice questions related to their intentions to persist in an engineering field. This instrument also includes a direct measure of engineering identity and items related to indirect measures of engineering identity; including constructs of engineering performance/competence, interest, and recognition. Further, we asked questions regarding participants' demographic information and family backgrounds, such as mother's educational level. We also surveyed students' engineering experience, such as participation in engineering-related student organizations.

A total of 765 mechanical engineering undergraduate students completed the survey in the 2016-2017 academic year. T-tests and two-sample proportion Z-tests of independence were used to compare differences in survey responses between the HSI and PWI students. To address the first research question, we analyzed the responses from Hispanic students at both institutions (n=429). The results suggest that Hispanic HSI students exhibited a stronger engineering identity, greater interest in engineering, and stronger desire to work in an engineering job after graduation, as compared to PWI Hispanic students. PWI Hispanic students, however, exhibited higher rates of participation in engineering-related student organizations. For the second research question, we ran similar analyses comparing Hispanic and non-Hispanic white students from PWI (n=411). The only statistically significant difference between the groups to emerge was the mothers' education level, which was higher for non-Hispanic students. To address the third research question, we ran similar analyses comparing Hispanic and non-Hispanic white students from HSI (n=354). No statistically significant differences emerged between Hispanic and non-

Hispanic white students. Ultimately, this analysis may suggest that interventions targeted at raising student interest and connection to the profession may have a greater likelihood of impacting the engineering identity development of Hispanic students. Future studies will build on this work to develop models for predicting engineering identity development of Hispanic students.

Introduction

Engineering identity has emerged as a potential lens for improving recruitment, retention, and persistence of students in the engineering profession [1] - [3]. The hypothesis is that, if educators can understand what an engineer's identity is and how it develops, then they can better help a diverse student population develop this identity, thereby increasing student persistence and diversity. To construct a framework for understanding engineering identity development, several identity theories have been utilized from the field of psychology (Table 1).

Table 1. A Sample of Identity Theories from Psychology used in Developing Engineering Identity Frameworks

Author	Identity Theory	Identity Framework
Tate & Linn [4]	Situated Cognitive	Multiple Identities
Tonso [5]	Cultural Production	Not explicitly stated
Tonso [6]	Not explicitly stated	Adapted Nespor's three dimensions for understanding campus curricular structures
Stevens et al. [7]	Not explicitly stated	3-part pathways framework: accountable disciplinary knowledge, engineering identity, and navigating engineering education
Matusovich et al. [8]	Expectancy Value	Multiple Identities (Nature, Institutional, Discourse, Affinity)
Pierrakos et al. [9]	Social Identities	Multiple/Collective Identities
Perirakos et al. [10]	Social and Organizational Identity	Not explicitly stated
Matusovich et al. [11]	Multiple Identities	Multiple Identities
Sheppard et al. [12]	Motivation as a surrogate for Identity	Not explicitly stated

Most notably, engineering education researchers have converged on the use of Multiple Identities framework [4], [8], [9], [11] based on a variety of identity theories, though many include social and cultural elements (e.g., [4], [9]). Based on these theories, several studies have

used semi-structured interviews to extract key attributes of engineering identity from a cross-section of students at multiple institutions [11], throughout the four years of an engineering degree [5], while working on design teams [6], to identify differences across genders [4], [10], and ethnicities [4], [13], and assess the impact that attending a minority-serving institution has on minority student development of an engineering identity [13].

Based on the proposed use of identity as a lens for educational research by Gee [14] and expanded on by Carlone and Johnson [15] and Hazari et al. [16] to encompass math and science, a framework for engineering identity has been popularized that includes an individual's sense of competence/performance, engineering interests, and recognition as an engineer by others [2], [3], [17]. In an attempt to quantify engineering identity using these constructs, Godwin et al. used structural equation modeling to predict whether students would pursue a degree in engineering based on their physics, math, and general science identities extracted from their responses to the Sustainability and Gender in Engineering (SaGE) survey [1]. Prybutok et al. later adapted the survey developed by Godwin et al. to assess engineering identity separately from math and science [2].

In this study, we are particularly interested in Hispanic engineering students due to their underrepresentation in the field and prior engineering identity studies. After decades of focus on increasing diversity, Hispanic students remain underrepresented in engineering [18], [19]. In 2012, the percentage of engineering bachelor's degrees awarded to Hispanic/Latino students was 9.0% [18]. With these individuals estimated to make up 17.1% of the USA population, they are still markedly underrepresented in engineering [19]. Further, few of the prior identity studies have focused on quantifying the engineering identity of Hispanic students nor on understanding the factors contributing to the engineering identity of Hispanic students. Rather, those studies looking at Hispanic student identity development tend to focus on science identity [15], [21], or use motivation as a surrogate for identity [12].

One mixed method study did assess engineering identity of male and female engineering sophomores who attended minority-serving institutions, including Black students from two Historically Black Colleges and Universities (HBCUs) and Hispanic students attending two Hispanic Serving Institutions (HSIs) [13]. Their findings indicate that the Black and Hispanic students surveyed equated engineering identity with being a student of engineering. One point to note is that, in attempting to quantify engineering identity in this study, the authors equate identity with items of retention and persistence, rather than measuring identity directly. Further Black and Hispanic students derived part of their engineering identity from the inherent challenge associated with studying engineering and felt that the caring relationships they had with professors and peers strengthened their identity. The authors suggested that these caring relationships might be attributed to the minority-serving institution setting. With regards to the importance of attending a minority-serving institution, Black students specifically mentioned the importance of attending an HBCU. For Black students, attending an HBCU played into the decision of which university they would attend. Hispanic students, on the other hand, did not show evidence that they were aware that they were attending an HSI. Therefore, it is unclear as to what role attending a Hispanic Serving Institution has on Hispanic student engineering identity development. The role of attending an HSI versus a predominantly white institution is ultimately the focus of this study.

Overall, 472 HSIs enrolled nearly two-thirds (64%) of Latino/a undergraduates in 2016 [22]. Of Hispanic students pursuing engineering degrees, at least 59% obtain their degrees from HSIs [23]. Therefore, understanding how these institutions, which directly influence a majority of Hispanic engineering students, impact a student's engineering identity is valuable. As described by Lent et al. [24] and expanded on by Estrada et al. [25], social influence, that feedback students receive from individuals in their environment, is a powerful factor in Hispanic students' persistence. Further, as documented by Alonso [26], Hispanic students have expressed the value of establishing a *familia* within their engineering community. However, Alonso's study [26] investigating engineering identity development of Hispanic engineering students was conducted at a conference held by a specific Hispanic professional engineering society. As mentioned in the study limitations, Alonso's Hispanic population, therefore, may not be representative of typical Hispanic engineering students. Due to self-selection into the society and the conference, the population may have had a higher ethnicity identity and persistence in engineering. Given the importance of community to Hispanic students and the role in which institutions can play in forming that community, in this study, we focus on attempting to both measure Hispanic engineering identity and begin to understand how it differs between HSIs and PWIs. By doing so, we hope to be better able to identify those factors most influencing Hispanic engineering students' engineering identity development.

Research Questions

This research paper investigates how Hispanic engineering students develop their identity as engineers. Hispanic engineering students are of particular interest due to their underrepresentation in the field and prior engineering identity studies. In particular, we seek to assess the role of extracurricular experiences, familial influence, and institutional type on Hispanic students' engineering identity development by answering the following research questions:

1. How do the engineering identity, extracurricular experiences, post-graduation career plans, and familial influence of Hispanic students attending a Hispanic Serving Institution (HSI) differ from those of Hispanic students attending a Predominantly White Institution (PWI)?
2. How do the same measures differ for Hispanic students attending a PWI from those of non-Hispanic white students at that PWI?
3. How do the same measures differ for Hispanic students attending an HSI from those of non-Hispanic white students at that HSI?

These particular research questions are of interest as they allow us to distinguish between the impacts of institutional type (RQ 1) and ethnicity (RQ 2 and 3) on student development. We are also interested in understanding the differences in extracurricular experiences of Hispanic students due to the role that these experiences play in student self-efficacy and academic engagement [27]. Familial influence is also of interest due to prior studies that have linked family support to self-efficacy and persistence [28].

Methodology

This study utilized quantitative research analyses (i.e., descriptive analysis, t-tests, and two sample proportion Z-tests) of engineering identity development of Hispanic students. This study is part of a larger project focused on engineering identity across multiple institutions [3]. However, after collecting our initial data, we noticed interesting trends that motivated us to focus on the Hispanic student population. This section explains the methodology followed in our quantitative study of engineering identity of Hispanic students; including a description of the target institutions, the survey instrument, and how data were collected, cleaned, and analyzed.

Participant Demographics and Institutional Information

Participants in the study were mechanical engineering (ME) students from two four-year institutions. Both institutions are from The University of Texas System. They include one Hispanic Serving Institution (HSI) and one Predominantly White Institution (PWI). At the PWI, The University of Texas at Austin (UT Austin, www.utexas.edu), students are admitted directly into their specified majors as there is no general engineering program offered for first-year students. The HSI, The University of Texas at El Paso (UTEP, www.utep.edu), does offer a first-year pre-engineering program for all entering engineering students. Therefore, students typically begin their major-specific courses at the start of their second year at the HSI.

Additional differences between UT Austin and UTEP include general admission policies and type of students attending the institutions. The HSI has a more open enrollment policy; nearly 100% of applicants are accepted, while the PWI is more selective. The HSI predominantly serves Hispanic students (84.9% Hispanic and 8.5% Non-Hispanic whites [29]) while the PWI serves a more traditional higher education population (15.7% Hispanic and 39.8% Non-Hispanic whites [30]). Survey participants include students in their respective mechanical engineering programs and pre-engineering students at the HSI intending to complete a major in mechanical engineering. We surveyed first through fourth-year students at both institutions.

Survey Instrument and Data Collection

The survey instrument we used was borrowed from previous engineering identity studies' scales to address engineering identity and engineering factors, such as engineering competence/performance, engineering interests, and recognition as an engineer by others [1], [2], [3]. To measure engineering identity, we used the average of two survey items: an engineering identity Venn diagram with eight response options [3], [17] and an 8-point Likert-style scale question: "To what extent does your own sense of who you are (i.e., your personal identity) overlap with your sense of what an engineer is (i.e., the identity of an engineer)?" We also asked questions related to the engineering students' intention to complete a major in engineering, work in an engineering job after graduation, or go to graduate school in an engineering discipline. All of these questions used a five-point Likert-style response scale. Further, we asked whether they had completed an engineering internship or co-op, engineering undergraduate research project, or participated in an engineering-related student organization. We requested demographic information from students, including their mother's highest level of education and whether any

of their parents had earned an engineering degree. We retrieved participants' gender, ethnicity, and academic classification from university records following survey administration.

The survey, which took approximately fifteen minutes to complete, was administered in-class electronically between the second and fourth weeks of the fall 2016 and spring 2017 semesters in a total of twelve mechanical engineering courses each semester: eight PWI institution courses and four HSI institution courses. In an attempt to ensure that all mechanical engineering students completed the survey, we targeted one required core mechanical engineering course in each academic year. Of the courses in which the survey was administered, six were designated by the institutions as lower-division (first and second-year level) and six were upper-division (third and fourth-year level). Students with more than one declared major were retained in the analysis as long as one major was mechanical engineering.

Our study includes a total of 765 participants (592 male and 173 female) after removal of incomplete responses. The response rate of the survey was approximately 70%. Based on their classification found in university enrollment records, 33% were first-year, 21% were second-year, 25% were third-year, and 21% were fourth-year students from across the two institutions at the time of data collection.

Data Cleaning and Analysis

To measure reliability, we calculated Cronbach alpha values for engineering identity, engineering performance/competence, engineering interest, and recognition as an engineer by others. All alpha values ranged from 0.79 to 0.87, above the acceptable standard of 0.70 [31]. The "intent to complete a major in engineering" variable was too skewed towards "strongly agree" for all subpopulations. Therefore, we did not include that variable in the analysis for this study.

The two main analyses we used to compare differences in the data were t-tests and two-sample proportion Z-tests. We performed these analyses in three groups corresponding to the research questions listed above: HSI Hispanic versus PWI Hispanic responses, PWI Hispanic versus PWI non-Hispanic white responses, and HSI Hispanic versus HSI non-Hispanic white responses. For the t-tests, we conducted Levene's test for each variable to confirm the variances in the two groups are similar. If the Levene's tests were significant, we ran t-tests with unequal variance; otherwise, we ran equal variance t-tests. For all the t-tests and proportion Z-tests conducted, the difference in means was considered significant if the p-value was below 0.01 (a more conservative threshold) due to the large number of tests performed.

Results

The total number of participants in the study (n=765) and the number of Hispanic versus non-Hispanic white participants at each institution are listed in Table 1 for reference. The following are results from the quantitative analysis for each of the three research questions.

Table 1. Participant Demographics

	HSI - UTEP	PWI – UT Austin	Total in Ethnicity
Hispanic	335	94	429
Non-Hispanic White	19	317	336
Total in Institution	354	411	765

RQ1. How do the engineering identity, extracurricular experiences, post-graduation career plans, and familial influence of Hispanic students attending The University of Texas at El Paso (UTEP), a Hispanic Serving Institution (HSI) differ from those of Hispanic students attending The University of Texas at Austin, a Predominantly White Institution (PWI)?

In comparing the impact that attending an HSI vs. PWI has on Hispanic engineering students, we found that the HSI Hispanic students and the PWI Hispanic students significantly differ in their engineering identity and engineering interest (Table 2). In each of these factors, the HSI Hispanic students rated themselves higher than did their PWI counterparts. Two-sample proportion Z-tests show that PWI Hispanic students reported that they participated significantly more in engineering-related student organization than HSI Hispanic students (Table 2).

Table 2. Comparison of Mean Responses from Hispanic Students at the HSI and PWI

Construct/Variable	Mean (S.E.)			p-value
	HSI	PWI	Difference	
Engineering identity ¹	5.80 (.08)	5.25 (.13)	0.55 (-.05)	0.0006*
Engineering performance/competence ¹	4.07 (.03)	4.01 (.07)	0.06 (-.04)	0.4486
Engineering interest ¹	4.62 (.04)	4.39 (.08)	0.23 (-.04)	0.0032*
Recognition as an engineer by others ¹	4.10 (.05)	4.06 (.08)	0.04 (-.03)	0.7081
Working in an engineering job after graduation ¹	3.78 (.03)	3.57 (.08)	0.21 (-.05)	0.0235
Go to graduate school in an engineering discipline ¹	3.78 (.05)	3.53 (.15)	0.25 (-.10)	0.1171
Internship or co-op experience ²	0.18 (.02)	0.27 (.05)	-0.09 (-.03)	0.0727
Mother's academic education level ²	0.41 (.03)	0.55 (.05)	-0.14 (-.02)	0.0148
Parents earned in engineering degrees ²	0.21 (.02)	0.27 (.05)	-0.06 (-.03)	0.2395
Engineering related student organization ²	0.49 (.03)	0.77 (.05)	-0.28 (-.02)	0.000*
Undergraduate research experience ²	0.16 (.02)	0.21 (.04)	-0.05 (-.02)	0.2135

¹T-test, ² Two-sample proportion Z-test, * $p < 0.01$

RQ 2. How do the same measures differ for Hispanic students attending a PWI from those of non-Hispanic white students at that PWI?

In comparing Hispanic and non-Hispanic white students at the PWI, the only statistically significant difference found was that non-Hispanic white students' mothers had a higher academic education level on average than Hispanic students' mothers (Table 3). Therefore, no appreciable difference in engineering identity, performance/competence, interest, or recognition constructs was found between Hispanic and non-Hispanic white students at the PWI.

Table 3. Comparison of Mean Responses from Hispanic and Non-Hispanic White Students at PWI

Construct/Variable	Mean (S.E.)			p-value
	Hispanic	White	Difference	
Engineering identity ¹	5.25 (.13)	5.05 (.08)	0.20 (.05)	0.2117
Engineering performance/competence ¹	4.01 (.07)	4.03 (.04)	-0.02 (.03)	0.8123
Engineering interest ¹	4.39 (.08)	4.22 (.05)	0.17 (.03)	0.0966
Recognition as an engineer by others ¹	4.06 (.08)	4.13 (.04)	-0.07 (.04)	0.4606
Working in an engineering job after graduation ¹	3.57 (.08)	3.59 (.05)	-0.02 (.03)	0.8513
Go to graduate school in an engineering discipline ¹	3.53 (.15)	3.34 (.08)	0.19 (.07)	0.2748
Internship or co-op experience ²	0.27 (.05)	0.39 (.03)	-0.12 (.02)	0.0266
Mother's academic education level ²	0.55 (.05)	0.86 (.02)	-0.31 (.03)	0.000*
Parents earned in engineering degrees ²	0.27 (.05)	0.33 (.03)	-0.06 (.02)	0.2320
Engineering related student organization ²	0.77 (.04)	0.73 (.03)	0.04 (.01)	0.4711
Undergraduate research experience ²	0.21 (.04)	0.18 (.02)	0.03 (.02)	0.4720

¹T-test, ² Two-sample proportion Z-test, * $p < 0.01$

RQ3. How do the same measures differ for Hispanic students attending an HSI from those of non-Hispanic white students at that HSI?

In answering our final research question, Table 4 shows that none of the factors and variables were significantly different between Hispanic and non-Hispanic white students at HSI. It should be noted that this outcome could be due to the comparatively small sample size of the non-Hispanic white students at the HSI (n=19).

Table 4. Comparison of Mean Responses from Hispanic and Non-Hispanic White Students at HSI

Construct/Variable	Mean (S.E)			p-value
	Hispanic	White	Difference	
Engineering identity ¹	5.80 (.08)	5.92 (.35)	-0.12 (-.27)	0.7124
Engineering performance/competence ¹	4.07 (.03)	4.06 (.15)	0.01 (-.12)	0.9508
Engineering interest ¹	4.62 (.03)	4.53 (.15)	0.09 (-.12)	0.5388
Recognition as an engineer by others ¹	4.10 (.05)	4.16 (.21)	-0.06 (-.16)	0.7710
Working in an engineering job after graduation ¹	3.78 (.03)	3.58 (.14)	0.20 (-.11)	0.1476
Go to graduate school in an engineering discipline ¹	3.78 (.05)	3.32 (.28)	0.46 (-.23)	0.0578
Internship or co-op experience ²	0.18 (.02)	0.26 (.10)	-0.08 (-.08)	0.3774
Mother's academic education level ²	0.41 (.03)	0.58 (.12)	-0.17 (-.09)	0.1515
Parents earned in engineering degrees ²	0.21 (.02)	0.00 (.00)	0.21(.02)	0.0261
Engineering related student organization ²	0.49 (.03)	0.47 (.11)	0.02 (-.09)	0.9130
Undergraduate research experience ²	0.16 (.02)	0.37 (.11)	-0.21 (-.09)	0.0175

¹T-test, ² Two-sample proportion Z-test, * $p < 0.01$

Discussion and Future Work

Study Limitations

One limitation of this study is that the data was collected from only two institutions, a small sample size from which to draw fully generalizable conclusions. Characteristics, such as admissions selectivity, can be conflated with institution type. Further, both institutions in the study are large, public universities located in the state of Texas and members of the same state-wide school system. Therefore, results from our study may be specific to that particular state and school system network.

It should also be noted that 20% of the students at the PWI, UT Austin, identified as Hispanic at the time of the study, which is close to the 25% required for classification as an HSI [32]. Consequently, this PWI may not be representative of most PWIs across the country due to the higher representation of Hispanic students. However, 80% of the students at UTEP, the HSI in the study, identified as Hispanic at the time of data collection. Therefore, although UT Austin could be considered an emerging HSI, a large demographic difference remains between the two institutions in the study.

RQ1. How do the engineering identity, extracurricular experiences, post-graduation career plans, and familial influence of Hispanic students attending a Hispanic Serving Institution (HSI) differ from those of Hispanic students attending a Predominantly White Institution (PWI)?

As shown in Table 2, we found that Hispanic students at UTEP, the HSI, have a statistically significantly higher engineering identity than Hispanic students at UT Austin, the PWI. Statistically significant differences were found, when comparing the institutions, in the factors of engineering interest (higher at the HSI), plans to work in an engineering job after graduation (higher at the HSI), and participation in engineering-related student organizations (higher at the PWI). These results were unexpected, as the PWI's engineering program is ranked higher than the HSI's and is viewed as one of the top engineering schools in the country. These results are somewhat similar to that of Godwin et al. [1], who found in their structural equation model that engineering interest was also statistically different between the two institutions compared in that study while engineering performance/competence and recognition were not statistically different. However, the results show that institutional differences significantly contribute to the engineering identity of students attending the institutions and factors related to their development of an engineering identity, which suggest that institution type may provide valuable insight into student identity formation.

A potential explanation for this result is the cultural differences in place at each institution. Students at the HSI may attend college with the expectation that they are receiving a degree to pursue a very specific career (e.g., "I'm getting an engineering degree to be an engineer") while students at the PWI may attend college with the perspective that it will open many different opportunities for them in the future (e.g., "I'm getting an engineering degree because it will allow me to do many different things with my career"). This trend is reflected in the higher engineering interest and plans to work at an engineering job at the HSI. Student organization participation, however, is higher at the PWI, which may reflect greater importance placed on networking and skill-building outside of standardized engineering coursework by Hispanic students at the PWI. Anecdotally and in some studies [33], [34], we have found that students at HSIs are more likely to work full or part-time, care for family, and commute to campus than their PWI counterparts. This may explain the lower extracurricular involvement at the HSI. Overall, this may indicate that Hispanic students at HSI are more intentional in receiving an engineering degree to do an engineering job while Hispanic students at the PWI were less fixed and are interested in a broader range of career possibilities.

RQ 2. How do the same measures differ for Hispanic students attending a PWI from that of non-Hispanic white students at that PWI? & RQ3. How do the same measures differ for Hispanic students attending an HSI from those of non-Hispanic white students at that HSI?

As shown in Table 3, we found that there is no statistically significant difference in engineering identity between Hispanic and non-Hispanic white students at the PWI (RQ 2). The only significant factor between the two groups is student's mother's education level. As shown in Table 4, we also found that there is no statistically significant difference in engineering identity between Hispanic and non-Hispanic white students at the HSI (RQ 3). There were no significant factors between the two groups. Therefore, within each institution, there were no differences in how students viewed their engineering identity and what factors were important to their identity. Since there were no significant differences in engineering identity between minority and majority ethnicities at either institution, this may indicate that institutional differences are more impactful on overall engineering identity development than ethnicity. This finding is consistent with our literature review, in that engineering students attending minority-

serving institutions (MSI) have overall positive engineering identities influenced by their institution [13]. However, for the HSI, it should be noted that the sample size of non-Hispanic white students was small, which may have influenced the lack of statistical significance in the engineering identity and related factors between Hispanic and non-Hispanic white students.

Implications of Results and Future Work

Based on these results, we believe a closer look at institutional differences is warranted. More specifically, we need to identify what institutional programs and structures are the strongest influences on student engineering interest and plans to work in an engineering job after graduation at both the HSI and the PWI. These two factors are the two statistically significant factors found regarding differences in engineering identity in Hispanic students at both institutions.

Given the greater emphasis placed on obtaining an engineering job by the HSI students, one potential difference to investigate is whether classes at the HSI have a greater focus on connecting theory to practical applications. Early exposure to the practical applications of engineering, which is often relegated to upper-level design courses, could lead to a higher engineering interest and plans to work at an engineering job.

In addition to examining institutional differences, we need to explore differences between types of students attending each institution to determine if student characteristics lead them to choose a particular type of school. To determine whether differences are due to incoming student characteristics or institutional differences, the data can be further analyzed by separating upper-division and lower-division student responses followed by targeted qualitative interviews.

The implications of examining specific institutional differences and characteristics of students attending each institution expands on the current literature available regarding engineering identity. Typically, engineering identity studies examine the impact of ethnicity differences, rather than the impact of institution choice in engineering identity differences. However, in our study, the statistically significant differences in engineering identity between Hispanic students at the PWI and the HSI, along with the lack of statistical significance in engineering identity between Hispanic and non-Hispanic white students at both the PWI and the HSI, suggest that institutional differences may be more impactful than differences in ethnicity.

The next steps in the study include expanding on our quantitative results by collecting qualitative data through conducting individual interviews of Hispanic students at both the PWI and HSI. This will allow more in-depth information on student perspective of their engineering identity and influencing factors to be collected and analyzed. Given the emphasis placed by the HSI Hispanic students on engineering job attainment, we are also working on incorporating an affect towards the profession scale in a model of engineering identity [17] to predict student retention and engineering identity. Further, we will be expanding our quantitative data collection to five additional HSIs located in different regions of the country.

In this study, both Hispanic and non-Hispanic white students at each institution have a high intention to complete their degree in engineering. The collection of additional longitudinal

data and data from other institutions may help reduce this skew in the “intent to complete a degree in engineering” variable. We may receive different results once we have degree completion data for respondents in the current study or by collecting data at institutions with lower retention rates.

Conclusion

Due to their underrepresentation in the field and prior engineering identity studies, this research paper investigated how Hispanic undergraduate engineering students develop their identity as engineers. In particular, we assessed the role of extracurricular experiences, familial influence, and institutional type on Hispanic students’ engineering identity development. To do so, 765 mechanical engineering undergraduate students completed a survey focused on quantifying engineering identity development during the 2016-2017 academic year. From their responses, we found that Hispanic students at the University of Texas at El Paso (UTEP), a Hispanic Serving Institution (HSI), had a statistically significantly higher engineering identity than Hispanic students at The University of Texas at Austin (UT Austin), a Predominantly White Institution (PWI). UTEP Hispanic students also reported a higher engineering interest and greater intent to work in an engineering job after graduation, but lower participation in engineering-related student organizations than Hispanic students at UT Austin. When comparing Hispanic and White non-Hispanic students within each institution, we found that there was no statistically significant difference in engineering identity. The only significant factor between the two groups was mother’s education level at the PWI. Therefore, within each institution, there were no differences detected in how students viewed their engineering identity and what factors were important to their identity. This may indicate that institutional differences are more impactful on overall engineering identity development than ethnicity. Based on these results, we believe a closer look at institutional and cultural differences is warranted. More specifically, we need to identify what institutional programs, structures, and cultural practices are the strongest influences on student engineering interest and plans to work in an engineering job after graduation at both HSIs and PWIs.

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